UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

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JAN 17 1989

Charles B. Lewis
MD Department of the Environment
Hazardous & Solid Waste Management
Administration
CERCLA Projects Pre-Remedial Division
2500 Broening Highway
Baltimore, MD 21224

Re: Non-Sampling Site Reconaissance Report
Exxon Company (MD-091)

Dear Mr. Lewis:

Enclosed for your review and comment are two copies of the above referenced report. Based on this reconaissance and our preliminary hazard ranking system score we are not at present, considering any further remedial action under CERCLA at this location.

If you have any questions concerning this recon report, please call me at 215-597-0823.

Sincerely,

James P. Harper

James P. Harper
Maryland Project Officer

2 Enclosures

cc: MD-091

NUS CORPORATION
999 WEST VALLEY ROAD
WAYNE, PENNSYLVANIA 19087
215-687-9510

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November 10, 1988
T-585-8-11-57
68-01-7346

Ben Mykijewycz
U.S. Environmental Protection Agency
841 Chestnut Street
Philadelphia, PA 19107

Dear Mr. Mykijewycz:

Attached please find three uncontrolled final copies of the non-sampling site reconnaissance summary report for Exxon Company, USA, prepared under TDD No. F3-8808-23.

Please endorse below confirming that you have received the attached subject data and return the form to the above address.

Sincerely,

Garth Glenn /dg

Garth Glenn
Regional Operations Manager,
FIT 3

GG/dg

Attachments

Signature: Mark for Ben
Ben Mykijewycz

Date: 11/14/88

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R-585-10-8-59

NON-SAMPLING SITE RECONNAISSANCE SUMMARY REPORT
EXXON COMPANY, USA
PREPARED UNDER

TDD NO. F3-8808-23
EPA NO. MD-091
CONTRACT NO. 68-01-7346

FOR THE

HAZARDOUS SITE CONTROL DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY

NOVEMBER 9, 1988

NUS CORPORATION
SUPERFUND DIVISION

SUBMITTED BY	REVIEWED BY	APPROVED BY
Randy Patarcity for	Randy Patarcity	Thomas W. Fromm
DONNA DAVIES	RANDY PATARCITY	THOMAS FROMM
ENVIRONMENTAL SCIENTIST	AGRICULTURAL ENGINEER	ASSISTANT MANAGER

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Scope of Work

NUS FIT 3 was tasked to conduct a non-sampling site reconnaissance of the Exxon Company, USA site, located in Baltimore, Maryland (see figure 1, page 2).

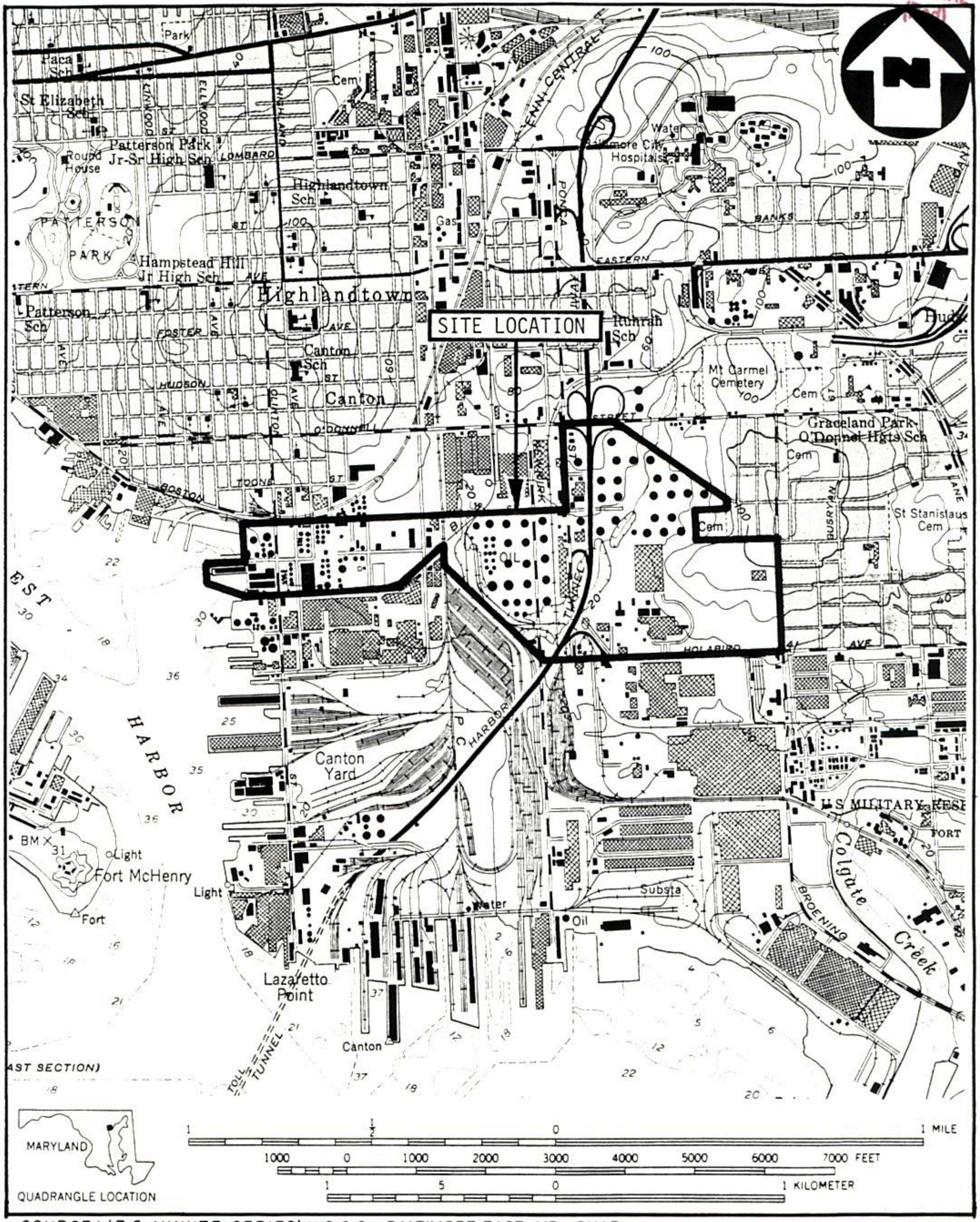
Background Information

An oil refinery, owned by Exxon Company, USA, operated at the site from 1865 until 1965. In 1965, active operations on site were discontinued and the site was converted to a storage depot and terminal. When Exxon was active on the site, portions of the property were utilized for weathering and burial of waste sludge, slope emulsions, and leaded tank bottoms. The contaminants of concern associated with these wastes are hexavalent chromium and lead. At this site, weathering was considered a safe and effective method for decomposing organic lead compounds into inorganic lead compounds. Probable burial locations were in the northeastern portions of the property (see figure 2, page 3). A tank field was located in one area adjacent to Dundalk Avenue. The other alleged burial area was a vacant lot.

In 1985, Exxon sold the property to the city of Baltimore. Portions of this property were utilized by Exxon for sludge weathering and burial. According to Exxon representatives, prior to closure of the sale of the land, the property was sampled by the city of Baltimore in order to document the presence of contamination. Allegedly, extensive soil borings were taken and tested. Neither Exxon nor the city of Baltimore possesses the results from the sampling. The city of Baltimore has since sold the properties for development. One area of the property has been developed into a truck stop by Truck Plaza Limited Partnership; the other area has been developed into a hotel/travel plaza named Baltimore Business Plaza.

Sampling to Date

According to Exxon representatives, prior to construction on this property, extensive soil borings and testing occurred. No sample results are available.



SOURCE: (7.5 MINUTE SERIES) U.S.G.S. BALTIMORE EAST, MD., QUAD.

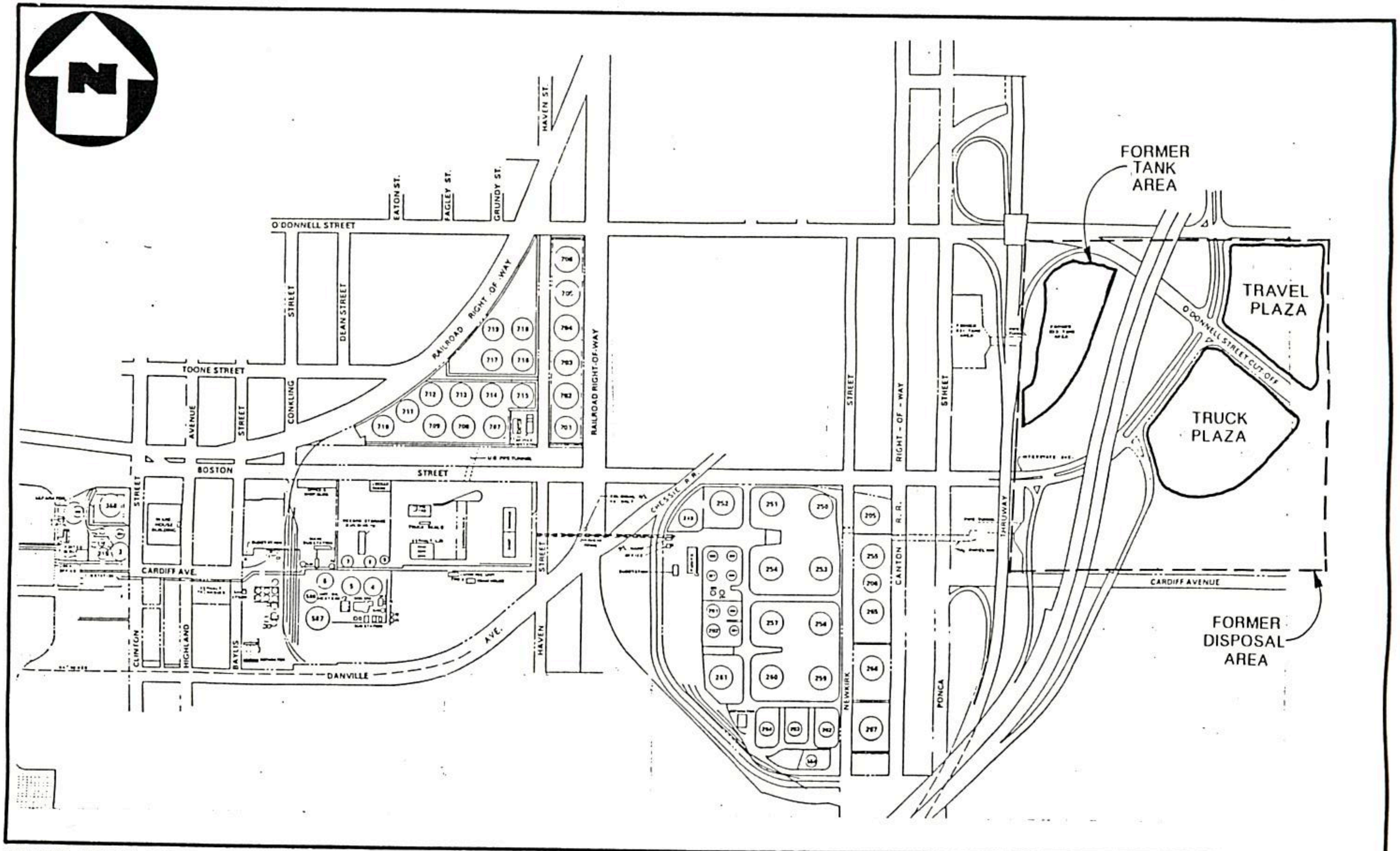
SITE LOCATION MAP

EXXON CORPORATION

SCALE 1: 24000

FIGURE 1

NUS CORPORATION



SOURCE: EXXON CORPORATION, USA.

FIGURE 2

SITE SKETCH
EXXON CORPORATION
(NO SCALE)

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Drinking Water Supply

There are no known domestic wells within a three-mile radius of the site. The city of Baltimore receives water from three surface water reservoirs located outside the three-mile radius and north and west of the city. The names of the reservoirs are Montebello Lake, Ashburton Lake, and Druid Park. Residents west of the site, in Baltimore County, receive public water from the Baltimore Municipal Water Authority. The Baltimore Municipal Water Authority obtains its water from the three Baltimore City reservoirs, as well as seven additional reservoirs named Pretty Boy, Lock Raven, Liberty, Gilbert, Towson, Lake Ronald, and Faillfith Lake. All of the reservoirs are located outside the three-mile radius.

Geology Information

The site is located in the Coastal Plain Physiographic Province. This province consists of Cretaceous and Quaternary age unconsolidated sediments that form a wedge-like body over the eastward-sloping Precambrian and Early Paleozoic age crystalline bedrock. These sediments dip and thicken toward the southeast and were deposited during repeated sea transgressions and regressions. The thickness of the unconsolidated sediments under the site is estimated to be approximately 250 feet.[1,2]

Specifically, the site is immediately underlain by the Patapsco and Arundel Formations of Lower Cretaceous age. These formations are the upper two members of the Potomac Group. The lowest member of the Potomac Group is the Patuxent Formation, which underlies the Arundel Formation, at a depth of approximately 120 feet. Two facies of the Patapsco Formation crop out at the site. The clay facies occurs at the extreme eastern edge of the property and consists of buff red-yellow and brown, mottled kaolinitic clay. Variable amounts of quartz sand and silts also occur as pods or are interbedded throughout this facies. The sand facies of the Patapsco is mapped in the central and southern portions of the site and is well-sorted, medium- to fine-grained quartz sand with locally abundant quartz gravel and clay clasts. The thickness of the Patapsco ranges from 7 to 265 feet throughout the study area and is estimated to be between 30 and 50 feet thick under the site.[1,2]

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The clay facies of the Arundel Formation is mapped above the northwestern portion of the site. The Arundel Formation stratigraphically underlies the Patapsco and its clay facies consists of gray, brown-black to red, kaolinitic and illitic clay locally interbedded with quartz silt and sand lenses and pods. The thickness of the Arundel varies between 7 and 100 feet throughout the study area and is expected to be between 70 and 100 feet under the site.[1,2]

Artificial fill is mapped over a large area of the site. This fill consists of heterogeneous materials such as rock, unconsolidated sediment, slag, refuse, and dredge spoil. This was placed at the waterfront on Northwest Harbor and the Patapsco River. Also, fill has been placed in a wide band that roughly parallels the Harbor Tunnel Throughway, which runs through the site. The thickness of the fill is estimated to be between 10 and 15 feet.[1,2]

Specific soil information is not available. However, from observations of adjacent areas within Baltimore County and mapped by the Soil Conservation Service and from information provided by the geologic map of the area, it is assumed that a large portion of the site would be classified as Made land. Native soils on the site would most likely consist of the weathered clays and sands of the Patapsco and Arundel Formations.[2,3]

Groundwater Information

The sand facies of the Patapsco Formation is potentially the most viable aquifer mapped on the site. The clay facies of the Arundel Formation is not generally considered to be an aquifer and may act as a confining layer or aquiclude, permitting the development of artesian pressure in the underlying Patuxent Formation.[1,2]

Groundwater in the Patapsco Formation is unconfined and may be greatly influenced by the fluctuations of adjacent surface water bodies. Wells tapping this aquifer are primarily developed to provide industrial supplies within the Baltimore commercial area and may yield between 300 and 400 gallons per minute. Specific water level information is not available; however, estimates made from wells in similar topographic settings indicate that groundwater is less than 20 feet below the surface.[1,2]

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Summary of Activities

On September 14, 1988, NUS FIT 3 personnel Donna Davies, Randy Patarcity, and Brian Lynch conducted a non-sampling site reconnaissance of the Exxon Company, USA site. FIT 3 was accompanied on site by Richard Nock, Exxon Baltimore Terminal operations manager. Weather conditions were sunny and mild, with temperatures in the mid-70s. Photographs were taken during the site visit (see attachment 1).

Persons Contacted

Prior to Field Trip

James Harper
Site Investigation Officer
U.S. EPA
841 Chestnut Building
Ninth and Chestnut Streets
Philadelphia, PA 19107
(215) 597-3182

Hillary Miller
Maryland Waste Management
Administration
201 West Preston Street
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(301) 333-2950

Richard Nock
Terminal Operations Manager
Exxon Company, USA
3801 Boston Street
Baltimore, MD 21224
(301) 563-5118

Alan Williams
Maryland Waste Management
Administration
201 West Preston Street
Baltimore, MD 21224
(301) 333-2950

Richard Cieri
Environmental Specialist
Exxon Company, USA
P.O. Box 4415
Houston, TX 77210-4415
(713) 656-7752

Water Supply Well Information

No domestic wells are known to exist within three miles of the site. None were identified during the FIT 3 site visit; therefore, no home well questionnaires were distributed.

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Site Observations

- The HNU background reading was 0 ppm; no readings above background were recorded.
- The mini-alert setting was X1; no readings above background were recorded.
- The area of probable burial of sludges has been developed into a travel plaza and truck stop.
- The Patapsco River is located one mile south of the site.
- No evidence of hazardous waste was noted on site.
- The only remaining tank fields were located at New Kirk Street and Boston Street.
- Tankers from the Northwest Harbor were observed unloading oil at the docks on the western portion of the property.
- Equipment that was utilized for asphalt manufacturing was present to the south of Boston Street. Asphalt production ceased at the terminal in 1984.

Geology and Groundwater References

1. Maryland Board of Natural Resources. Water Resources of Baltimore and Harford Counties. Bulletin 17, 1957.

2. Maryland Department of Natural Resources, Maryland Geologic Survey. Geologic Map of the Baltimore East Quadrangle. 1979.

3. United States Department of Agriculture, Soil Conservation Service. Soil Survey of Baltimore County, Maryland. March 1976.

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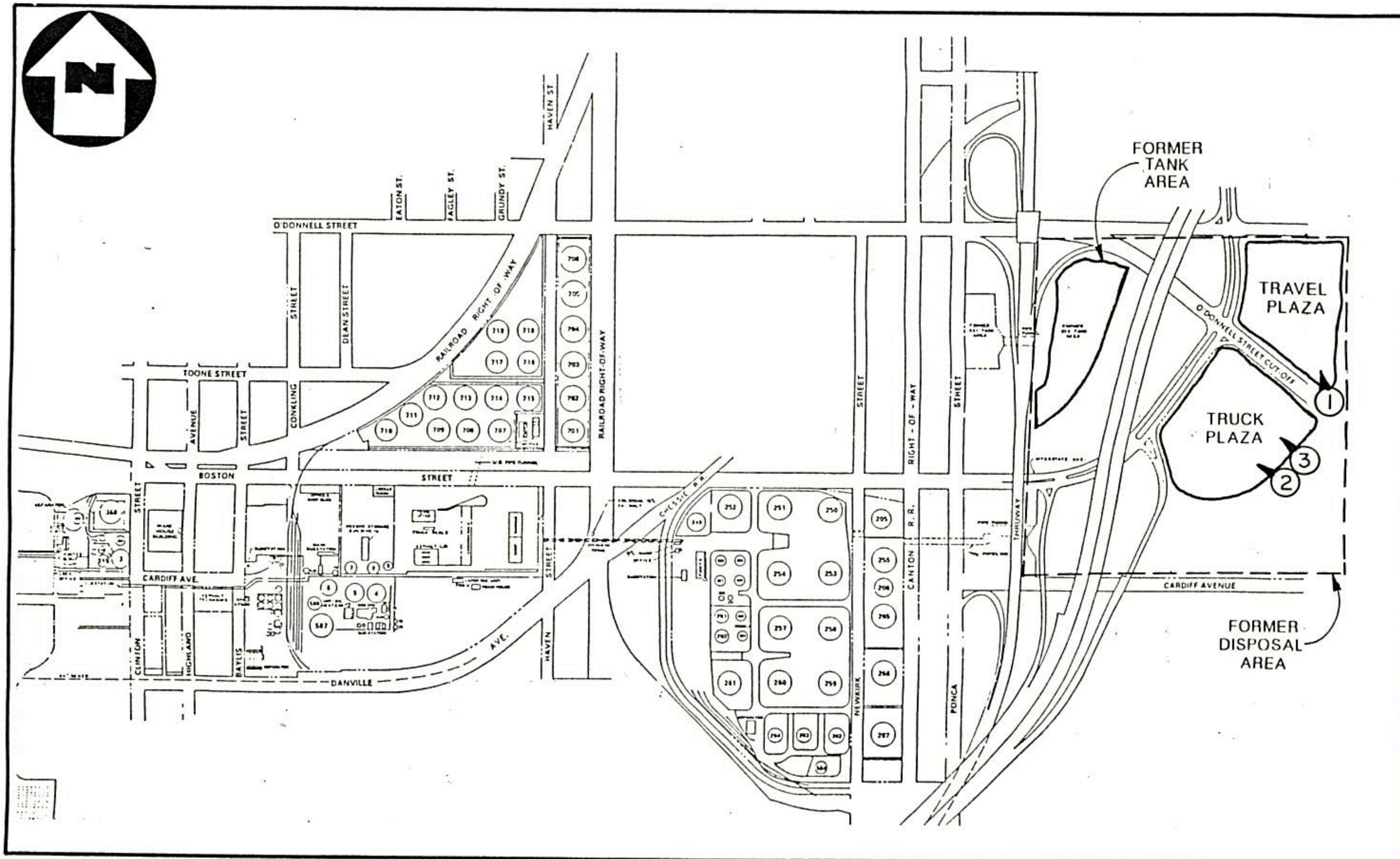
ATTACHMENT 1



SOURCE: EXXON CORPORATION, USA.

FIGURE 3

PHOTO LOCATION MAP

EXXON CORPORATION

(NO SCALE)

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ATTACHMENT 2

PHOTOGRAPH LOG

Photo 1-
View of travel plaza constructed
on old disposal area

Photo 2,3-
Panorama of truck plaza construc-
ted on old disposal area

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sludge disposal

One of two methods is commonly used for disposing of sludge from leaded-gasoline storage tanks. They are "burying" or "weathering". Both methods are recognized by API RP-2015. There are other effective methods, such as "thermal" methods, but they are not commonly used because special facilities are required.

BURYING—In this method a pit is dug either manually or by bulldozer. The sludge is dumped into the pit and then covered with 1 to 2 feet of fresh earth. This area should be adequately marked so that no one inadvertently uncovers the buried sludge. Experience indicates that buried organic lead compounds decompose very slowly to inorganic materials. If a ditch or trench is dug through the sludge pit, organic lead compounds may be uncovered.

WEATHERING—This method is safe, effective, and economical. Laboratory tests show that organic lead compounds in sludge when exposed to the elements will decompose to inorganic lead compounds. Laboratory and field tests show that if the procedures, as outlined in this section are followed, there will be no special air, soil, or water contamination problem. The basis for this is: (1) The total quantity of organic lead in a sludge weathering bed is small. Concentrations rarely exceed the normal range of 0.1 to 0.4 pounds organic lead per ton of sludge. (2) Regardless of the concentrations or total quantity of lead in the sludge weathering bed, the amount of organic lead exposed to the atmosphere at the surface of the weathering bed is very small. Lead-in-air tests taken over or immediately downwind of the weathering bed indicate that lead-in-air concentrations do not exceed the threshold limit value for organic lead. This indicates the atmosphere in the area is essentially safe from an occupational health hazard standpoint as soon as the sludge is spread. (3) Organic lead compounds are dissolved in the gasoline hydrocarbon fractions of the sludge and do not migrate into water or soil. Thus, the physical properties of organic lead in sludge in the weathering beds are such that vaporization, absorption in water or soil do not constitute a health problem.

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"WEATHERING" PROCEDURE FOR DISPOSAL OF SLUDGE FROM LEADED GASOLINE STORAGE TANKS

1. Location of disposal area:
   a. The site selected for sludge disposal should be in a remote part of the tank owners property and within property limits where it can be fenced off from th public. It should be located away from buildings. If the sludge is spread near t tank being cleaned, it should be outside the surrounding firewall, so that the possibility of gasoline vapors affecting the tank cleaning operations will be eliminated.
   b. The disposal area should be located so that personnel working in, on, or around the tank will not get into the spreadout sludge.
   c. It can be a bare ground, grass or concrete surface.
   d. It must be fairly smooth and well drained so that water will not stand on it.
   e. The total area, whether in one or several patches, must be sufficiently large to permit spreading the sludge in a layer not over 3" thick. The total area required will, of course, be determined by the amount of sludge in the tank.
   f. It should be so located that air can circulate freely over the surface of the sludge. Exposure to the sun is desirable but not mandatory.

2. Remove sludge from the tank in the usual manner following the safety recommendations approved by API.

3. The sludge can be moved from the tank to the spreading area in available plant equipment. Wheelbarrows, buckets or other small containers may be used for moving it a short distance. Dump trucks, lugger buckets, etc., may be used for longer distances. The containers used should be metal. After use, they should be washed thoroughly with water.

4. The sludge can be spread with hoes, rakes or shovels. It should be spread as uniformly as possible to a *maximum thickness of three inches*. If the area permits it, a thinner spreading is desirable.

5. Personnel handling and spreading the sludge should be dressed in special clothing as recommended for tank cleaning. Normally, masks will not be necessary if there is air movement.

6. After the spreading is completed the sludge patch or patches should be roped off and marked so that no one will walk through or stand in the sludge.

7. While sludge will normally weather within four weeks when the sludge temperatur is above 32 degrees F, lead-in-sludge tests should be made before declaring it a nontoxic waste material. The number of days during which sludge temperatures are 32 degrees F or lower should be excluded from the four-week weathering period. If after the four-week weathering period the organic lead content is 20 part per million or less, 0.002 weight percent, the sludge may then be treated as any other nontoxic waste material. It is then satisfactory to remove signs and fences. The sludge should remain in the preselected area.

Preprint No. 28a-63—Subject to Correction

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RELEASE AFTERNOON PAPERS TUESDAY, MAY 14

METHODS OF DISPOSING OF SLUDGE FROM LEADED GASOLINE STORAGE TANKS †

H. K. BALL *

ABSTRACT

For many years sludge from leaded gasoline storage tanks has been successfully disposed of by burial. Recently, inquiries have been received from a number of oil companies asking for an alternate method of sludge disposal. Available space for sludge pits is being exhausted, and in some areas high water tables offer disposal problems.

Various methods of sludge disposal were studied, including roasting, chemical treatment, leaching, etc. These methods, although effective, all have drawbacks. It was learned that the tetraethyllead would dissipate after spreading leaded sludge in a 3-in. layer. From tests that have been conducted to date, it appears that a weathering period of 30 days is adequate to reduce most sludges to a lead level of below 20 ppm, which is considered safe. Factors such as freezing weather could extend this period somewhat depending upon conditions.

Data are still being accumulated to further support this program.

Since the early 1930's, the potential toxicity of sludge from leaded gasoline storage tanks has been recognized. Therefore, it has been necessary to dispose of sludge by a method which would avoid harmful effects both from skin contact or inhalation of its vapors. Burial met these requirements.

In recent years, however, an increasing number of inquiries have been received from oil companies asking for an alternate method of sludge disposal because available space for sludge pits is being exhausted and in some areas high water tables create disposal problems.

In looking for alternate methods of sludge disposal, the basic requirements could be defined as follows:

1. Sludge should be reduced in the least possible time to a nonhazardous condition.

2. The method should be economical and should apply to tanks in all areas—refinery, terminal, bulk storage, etc.

3. The method should require no particular skill or technical assistance to perform it safely.

Possible methods for disposing of sludge were considered as follows:

1. *Chemical Methods* (applied after removing sludge from tank)

   a. Aqueous potassium permanganate.
   b. Sodium hypochlorite.
   c. Chlorine in acetic acid.
   d. Iodine solution.

2. *Thermal Methods*

   a. Ignition: Place a thin layer of sludge into a shallow but long and wide trench, cover with kerosine, and ignite with a torch. The heating must be for a sufficiently long period of time to vaporize all liquid from the sludge and heat the dried mass to approximately 150 C.

   b. Roasting: Place contaminated sludge on a large steel plate and heat with a flame to 150 C to 200 C. Heating may be applied in any manner.

3. *Physical Methods (Weathering Sludge):* Spread sludge in a thin layer and allow exposure to the elements.

4. *Combination of Preceding Methods:* Weathering followed by ignition or roasting.

5. *Miscellaneous Methods:* A host of other chemical decontaminants such as sulfuryl chloride in kerosine, hydrochloric acid, hydrogen peroxide, etc. were rejected because of secondary problems associated with use of these decontaminants.

Decontamination of sludge prior to removal from the gasoline storage tank (chlorine in the water wash) was rejected because of corrosion problems.

Advantages and Disadvantages of Various Methods

In the course of our investigations, it was agreed that:

1. Decontaminating sludge with chemicals (chlorine in acetic acid, iodine in potassium iodide solution, bleach, and potassium permanganate) is only partially effective and quite expensive. The chemicals react with other components of gasoline tank sludge and lose some of their effectiveness. Thorough mixing is essential for proper contact. This method is not considered feasible because of the difficulty of producing intimate contact of chemicals with sludge, the possible hazards of handling the chemicals, their cost, manpower requirements, and special equipment that may be required.

2. The most effective methods for decontaminating gasoline storage tank sludge are "thermal methods." Heating sludge to 200 C for 20 min after all moisture is removed reduces the tetraethyllead (TEL) content down to 0.00002 percent by weight. Heating may be carried out in a number of ways. However, the "thermal method" is only applicable when special facilities are available. The method may well require the removal of the sludge to a remote location involving rehandling of the material. Except under special circumstances, the economics do not appear good.

---

* Ethyl Corp., New York, N. Y.

† Presented to a session on operating practices during the 28th Midyear Meeting of the American Petroleum Institute's Division of Refining, in the Benjamin Franklin Hotel, Philadelphia, Pa., May 14, 1963; presiding, W. T. Askew, Sun Oil Co., Philadelphia, Pa.

and allowing it to "weather" has been proven an effective procedure for decontaminating sludge. Tests show that under Gulf Coast weather conditions, this method was superior to chemical treatment. This also proved true in mid-Continent area tests. In colder parts of the country weathering may be less effective as the sludge is in an inactive state because of low temperatures. However, as the weather moderates the weathering will continue.

Chemical Methods

The chemical methods were tested by removing portions (125 g each) from a large sludge sample and analyzing for TEL before and after treatment by methods shown in Table 1. The results from this test (Table 1) demonstrate that treating with halogens (which react instantly when in contact with TEL), potassium permanganate, and bleach considerably reduces the TEL content. *However, in no case did the decontaminants remove all TEL.*

A secondary problem presented itself in that all chemical decontaminants reacted with other components of sludge, presumably iron in its lower state of oxidation and organic petroleum compounds. This tends to use up the decontaminant.

Mixing sludge with chemical decontaminants appears to be necessary to improve contact with TEL. When potassium permanganate crystals were placed on the surface of sludge contained in a glass vessel, solution and diffusion of permanganate was extremely slow and not complete. Furthermore, the dilute permanganate solution was reduced by impurities in sludge more rapidly than it reacted with TEL.

Further tests to decontaminate sludge with potassium permanganate (1 lb permanganate to 99 lb sludge) proved unsuccessful. Even after stirring for 1 hr the TEL content was only reduced to 0.0022 percent by weight. Also, all potassium permanganate was reduced by this particular sludge sample. Based upon a cost of potassium permanganate at 26 cents per pound, this method appears to be quite expensive (approximately $8.50 per cubic yard of sludge for permanganate only. The equipment and labor costs would be even higher).

TABLE 1—Decontamination by Chemicals of Gasoline Storage Tank Sludge

Decontaminant	Active Part of Decontaminant, 1 Part to 99 Parts Sludge (Weight)	Contact Time (Days)	Unreacted TEL Percent of Sludge (Weight)
None (control sample)	...	...	0.0120
Chlorine in acetic acid	Chlorine	3	0.0022
Iodine–potassium iodide	Iodine	3	0.0006
Potassium permanganate ..	Permanganate	3	0.0023*
Bleach	Bleach	3	0.0049

* Constant stirring of a similar mixture for 1 hr resulted in a value of 0.0022 percent.

[illegible] percent by weight TEL to a single sample of sludge originally containing approximately 0.01 percent by weight TEL was readily decontaminated with chlorine in acetic acid to 0.0025 percent by weight of TEL. Apparently, TEL added to sludge is easy to decontaminate whereas TEL originally present in sludge is more difficult to decontaminate.

Thermal Methods

Thermal methods of *roasting* and *ignition* were tested and found to be effective, especially the former. A 300-g sample of sludge and a 2-lb sample of sludge were placed into steel trays and heated for 1 hr and 20 min. The temperature of the sludge remained below 100 C for the first hour (because of water on the sludge). During the next 20 min the temperature increased to 150 C on the surface and 200 C on the bottom layer.

The TEL content dropped to 0.00001 and 0.00002 percent by weight, respectively. This treatment appeared to be very promising because TEL and all other organic lead compounds are completely destroyed by heating.

The *ignition* method was tested by placing a 1-in. layer of wet sludge * in a tray and covering it with a thin layer of kerosine. The kerosine was then ignited. A relatively large volume of kerosine (1 volume kerosine to 4 volumes sludge) was needed to volatilize the moisture and reduce the TEL content to 0.0002 percent by weight. Two additions of kerosine were required to remove the moisture, and a third addition was necessary to increase the temperature of the sludge to a maximum of 145 C.

Burning air-dried sludge * with a kerosine and oil mixture reduced the TEL content to 0.00003 percent by weight. The use of kerosine only is not very satisfactory when using a deep bed of sludge (2 in.). Kerosine liquid and vapor prevent a rapid rise in the temperature of the sludge. The sludge bed acts as a wick, and if the temperature of the combustible vapor is not great enough, thermal decomposition of TEL is very slow. The use of a fuel with a higher boiling point is more effective for increasing the temperature of the sludge. For this reason, heating sludge with a flame or "roasting" is preferable to heating with a volatile solvent. The TEL content of a flame-heated sludge * sample (overhead flame) dropped to 0.00001 percent by weight.

Sludge-Weathering Method

In 1955 the Ethyl Corporation started a series of field tests involving the cleaning of leaded gasoline storage tanks. We were interested in what might be the maximum exposure hazard of lead vapors to personnel in a tank having contained leaded gasoline, and we were also interested in the nature of the sludge being removed from a tank. As a part of our study, sludge samples were sent to our chemical research and development laboratory in Baton Rouge for analysis. Sludge in glass bottles, standing in the laboratory before being analyzed, was found to stratify in layers composed of solids, gasoline, and water. It was further found that by centrifuging these samples, the TEL in the sludge can be removed.

* 0.012 percent by weight TEL.

was put in the sunlight and it was found that TEL diffused into the atmosphere. Further checking by the laboratory group showed that the level of lead in sludge exposed to the elements (with or without the sun being present) rapidly declined.

For this "weathering" process to be a satisfactory method of decontaminating sludge two questions had to be answered.

1. How low did the level have to be reduced to make the sludge safe?

2. How long would it take?

To answer the first of these it was reasoned that the sludge is safe if it will not contaminate the air above it. Tests were then made to see what the LIA (lead-in-air) values were in the air above "weathering" sludge. The results showed that the values are low at all times, even with no apparent wind. This meant that the sludge, as far as air contamination is concerned, is essentially safe as soon as it is spread in the open. To be on the safe side, however, Ethyl Corporation has set a figure at 20 ppm of organic lead as the limit in the sludge that can be considered safe in the open air after it has been "weathered."

In the early studies, sludge levels of various thicknesses were tried over a period of time. These are shown in Fig. 1 through Fig. 4. In addition to placing these on the ground, some were placed on steel plate with no apparent difference. These were small-scale tests.

Following this, full-scale tests were carried out at tank cleanings, two of which are shown in Tables 2 and 3.

The LIA values remained almost constant for the duration of both tests even though the lead content of the sludge was disappearing (Table 3).

From the LIA data, it was concluded that there is no danger of inhaling a harmful quantity of lead, provided there is nothing to restrict normal air movement.

The lead content of the sludge in about 3 weeks time dropped 90 percent or more in the 4-in-thick patches (Fig. 3) and 98 percent or more in the 2-in.-thick patches (Fig. 2).

Based on data such as this, it was decided that it would be entirely satisfactory to dispose of the con-

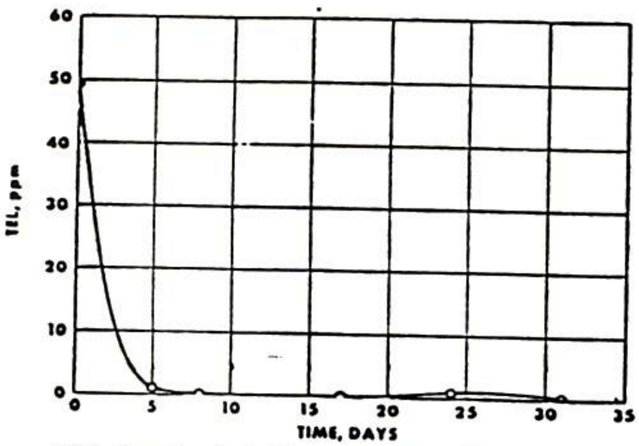

FIG. 1—One-Inch-Thick Sludge Weathered on Ground.

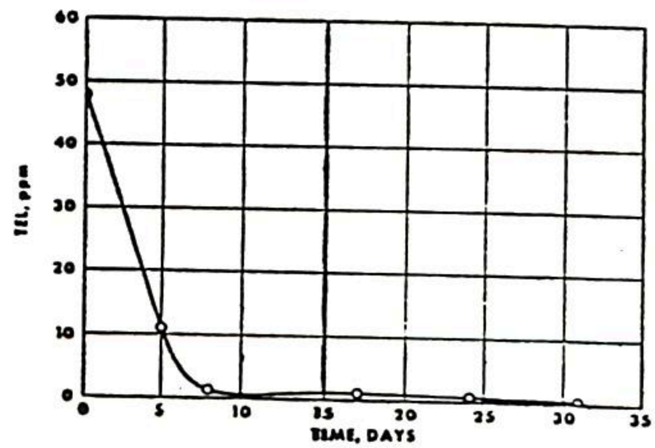

FIG. 3—Four-Inch-Thick Sludge Weathered on Ground.

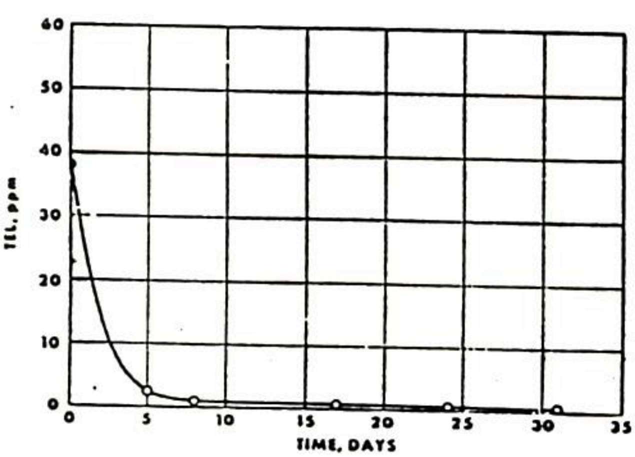

FIG. 2—Two-Inch-Thick Sludge Weathered on Ground.

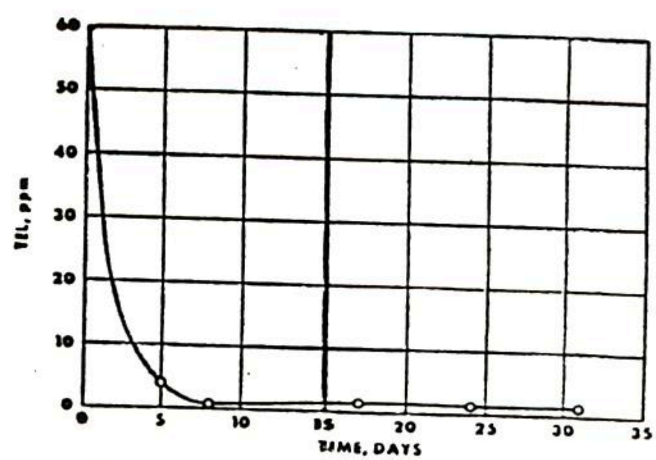

FIG. 4—Two-Inch-Thick Sludge Weathered on Steel Plate.

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tamination in sludge by weathering for a period of 30 days.

As this program continues, considerably more data is being accumulated to substantiate our findings. To date all data obtained has proved our original conclusions to be correct.

The following procedure was developed for disposal of sludge so that a uniform method would be followed in arriving at a satisfactory completion of a sludge-weathering program:

1. Location of disposal area:

a. The site selected for sludge disposal should be in a remote part of the property and within property limits where it can be fenced off from the public. It should be located away from buildings. If the sludge is spread near the tank being cleaned, it should be outside the surrounding firewall, so that the possibility of gasoline vapors affecting the tank cleaning operations will be eliminated.

b. The disposal area should be located so that personnel working in, on, or around the tank will not get into the spread-out sludge.

c. It can be a bare ground, grass, or concrete surface.

d. It must be fairly smooth and well drained so that water will not stand on it.

e. The total area, whether in one or several patches, must be sufficiently large to permit spreading the sludge in a layer not over 3 in. thick. The total area required will, of course, be determined by the amount of sludge in the tank.

f. It should be so located that air can circulate freely over the surface of the sludge. Exposure to the sun is desirable but not mandatory.

2. Remove sludge from the tank in the usual manner following the safety recommendations approved by the American Petroleum Institute.

TABLE 2—Typical Weathering Results

Weathering Time (Days)	TEL Content in Sludge in Parts Per Million	
	Two-Inch-Thick Patch	Four-Inch-Thick Patch
0	38.0	48.0
5	2.9	10.6
8	1.1	2.3
17	0.7	2.0
24	0.6	0.7
31	0.5	0.3

TABLE 3—Typical Lead-in-Air Readings

Weathering Time (Days)	Micrograms TEL per Cubic Foot of Air	
	Three Inches Above Sludge	Waist Level Above Sludge
1	1	1
2	1	1
5	1	1

3. The sludge can be moved from the tank to the spreading area in available plant equipment. Wheelbarrows, buckets, or other small containers may be used for moving it a short distance. Dump trucks, lugger buckets, etc. may be used for longer distances. The containers used should be metal. After use, they should be washed thoroughly with water.

4. The sludge can be spread with hoes, rakes, or shovels. It should be spread as uniformly as possible to a *maximum thickness of 3 in.* If the area permits it, a thinner spreading is desirable.

5. Personnel who handle and spread the sludge should be dressed in special clothing as recommended for tank cleaning. Masks will not usually be necessary unless there is no air movement and vapors can be detected by odor at face level.

6. After the spreading is completed the sludge patch or patches should be roped off and marked so that no one will walk through or stand in the sludge.

7. The spread sludge should be left for at least four weeks. After that it may be treated as any other nontoxic waste material. It is satisfactory to remove signs, fences, etc. and leave the sludge in the preselected area permanently. The four-week weathering period applies when the ambient temperature is above 32 F. Therefore, if temperatures under 32 F exist during the period of weathering, this period of subfreezing temperatures should not be included in the recommended four weeks of weathering.

8. Whenever the weathered sludge analyzes 0.002 percent by weight (20 ppm) organic lead or less, it may be considered safe and the sludge may then be treated as any other nonhazardous waste material.

To date we have examined over 100 weathered samples taken from tank cleanings and have definite results on 38. These weathered satisfactorily, the organic lead being reduced to less than 20 ppm. A number of samples had to be ruled out because we had no base line to start with, although we have reason to believe that these did weather satisfactorily.

This unquestionably is a radical departure from the early and original method of sludge burial. The new method was brought about by necessity; and, very fortunately, because of the curiosity of our people in our chemical research and development laboratories, we were able to bring to the field a method that, judging from figures received to date, is going to solve a lot of our sludge problems.

We are preparing a more detailed paper on some of the intricacies involved which, hopefully, should be published in several months.

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